Nucleic Acids and Protein Synthesis

I. DNA: The Heredity Material

A. Genetic Material and Transformation

1. By experimentation, Griffith found that material had been passed from one bacteria to the other changing the bacteria.

a. called a transforming factor

b. transformation- process by which bacteria are changed by absorbing genetic material from an outside source

2. After, scientists found evidence that DNA was the transforming factor

a. Avery, MacLeod, and McCarty

b. other scientists still not convinced

B. DNA and Bacterial Viruses

1. Chase and Hershey experimented with bacteriophages

a. These are viruses that infect bacteria

2. Phage virus is made of just protein and DNA

3. Used radioactive material (sulfur and phosphorus) in the virus

4. DNA is found to be the hereditary material

a. radioactive protein stays on the outside of the bacterial cell

b. radioactive DNA found on the inside of the bacterial cell

II. DNA: Structure and Replication

1. Four compounds in DNA: adenine, thymine, cytosine, guanine

a. amount of thymine equal to adenine

b. amount of cytosine equal to guanine

A. X-ray studies

1. DNA x-rayed using x-ray crystallography

B. DNA structure

1. Watson and Crick used research to determined the structure of DNA

a. DNA is long strands of nucleotides

b. nucleotides have deoxyribose (pentose sugar), phosphate group, and a nitrogen base

2. Differences in bases

a. purines are made of two rings – adenine and guanine

b. pyrimidines are one ring – thymine and cytosine

C. The Double Helix Model

1. DNA is two strands wrapped around each other

a. x-rays too wide to be single stranded

b. looked tightly coiled

c. sugar and phosphates are the backbone of the ladder

d. the bases make up the rungs of the ladder and meet in pairs

2. One purine and one pyrimidine make up a base pair

a. adenine pairs with thymine

b. cytosine pairs with guanine

c. each strand is complementary to the other

D. DNA Replication

1. Replication is the process by which DNA copies itself

a. the double helix unwinds

b. enzymes break the hydrogen bonds

c. now there are two strands

2. Each half of the DNA is now a template to make a new strand

a. free floating nucleotides come together to make a new half

b. DNA polymerase matches the base in the parent strand to its complementary base

c. a new backbone is built

d. an exact copy is made

III. DNA and the Genetic Code

A. DNA and Proteins

1. Each gene controls one enzyme

a. mutant bread mold could not make enzymes to synthesize amino acids

b. one gene one enzyme hypothesis by Beadle and Tatum

2. DNA controls all proteins, not just enzymes

a. one gene-one protein

3. DNA is a blueprint for making proteins

B. RNA

1. Protein synthesis is the making of proteins

2. Making of proteins occur in the cytoplasm

a. the code from the DNA in the nucleus is given to the RNA

b. RNA made of pentose sugar, phosphate, and bases

c. uracil is used instead of thymine

d. is single stranded

3. Three types of RNA

a. messenger RNA carries the coded instructions for protein synthesis from the DNA in the nucleus to the ribosome

b. transfer RNA brings the amino acids to the ribosome in the correct order so that they can make the protein

c. ribosomal RNA makes up the structure of the ribosome

C. Transcription

1. transcription is the process of transferring information from a strand of DNA to a strand of RNA

a. DNA unwinds

b. the strand with the gene is the template

2. RNA polymerase builds mRNA by matching bases to the DNA

a. enzymes link the nucleotides together

b. mRNA leaves the nucleus after transcription and goes to the ribosome to synthesize the protein

D. The Genetic Code

1. Each base does not code for an amino acid by itself

a. there are 20 amino acids and only 4 bases

2. The code word for each amino acid is three bases long and is called a codon

a. some codons start or stop

b. some amino acids have more than one codon

3. codes for amino acids are universal

a. all organisms on earth share the same genetic code

IV. Protein Synthesis

1. translation is synthesizing of proteins by ribosomes with the help of mRNA

2. single amino acids are carried by tRNA to the ribosome

a. tRNA has a region called an anticodon

b. anticodon bases complement those on mRNA

c. amino acids bond with the right tRNA

d. translation is when two ribosome units bond with mRNA and amino acids are added

e. elongation is building proteins one amino acid at a time

V. The Control of Gene Expression

1. Genes are turned on and off by many factors

a. in prokaryotes may be due to environment

A. Control in Prokaryotes

1. Some proteins are manufactured all of the time while others are not

2. An operon is a group of genes with related function

3. Operon contains genes that code for proteins

a. these are called structural genes

b. promoter genes promote movement of RNA polymerase into the structural genes

c. the operator is the on/off switch

4. Genes are turned off by a repressor protein made by the regulator

a. not part of the operon

b. high levels of the molecule being made will bind to the repressor and activate it

B. Control in Eukaryotes

1. When DNA is coiled tight (chromatin) it cannot be transcribed and is then inactive

a. growth factors and hormones may initiate uncoiling

2. methyl groups are also found on tightly coiled segments

3. regulatory proteins can interact with operator sections

4. introns are intervening base sequences not part of the protein code

a. exons actually code for the protein

VI. Gene Mutations

1. changes in series of nucleotides called a gene mutation

A. Kinds of Gene Mutations

1. Base-pair substitution

a. point mutation –only one base pair is substituted in a gene

b. may be harmless or harmful

c. sickle cell anemia

2. Deletion and addition

a. one or more bases is lost or gained in a gene

B. Mutagens and Cancer

1. Favorable mutations can adapt a species

2. Mutagens are factors in the environment that causes mutations

a. radiation

b. tobacco smoke

c. chemicals called base analogs

3. When genes that control growth and differentiation are affected, cancer results

a. mutagens are then called carcinogens

4. Can test for possibility of being carcinogenic by using the Ames test

5. Oncogenes are cancer causing genes